

halteres yellowish transparent basally, yellowish brown apically. Legs mostly yellowish gray and sparsely clothed with moderately long, whitish hairs; distal tarsal segments somewhat darker; claws moderately stout, evenly curved, finely denticulate and with a minute tooth subapically, the pulvilli a little shorter than the claws. Genitalia; basal clasp segment very short, broad; terminal clasp segment moderately long, narrowly oval; harpes extended, foliate, the basal angles produced laterally as chitinous, tooth-like processes, obliquely truncate; distal angles with the margin strongly chitinized and bearing three or four short, stout teeth. Type Cecid. 1649.

THE CARPENTER-BEES OF THE UNITED STATES OF THE GENUS XYLOCOPA.¹

BY ARTHUR J. ACKERMAN,

AMHERST, MASSACHUSETTS.

INTRODUCTION.

This paper forms the major part of a thesis for the degree of master of science at the Massachusetts Agricultural College, and it has been prepared under the supervision of Dr. H. T. Fernald. It is an endeavor to make more easy the identification of the bees of this genus.

The collections upon which the work in this paper is based are those of the American Entomological Society in Philadelphia, the United States National Museum, the Museum of Comparative Zoölogy of Harvard University, the Brooklyn Museum, the Children's Museum of Brooklyn, the collection of the Massachusetts Agricultural College, the private collection of Dr. G. C. Crampton, and other smaller collections. The few types existing in this country have been examined and descriptions made from them, added to by the examination of a large series of specimens; redescriptions of all the species and a key for their separation are also included.

Earlier works and literature found to be of great value in the preparation of this paper are: Illiger, *Magaz. f. Insectenk.*, 1806; Lepeletier, *Hist. Nat. Insect. Hymen.*, II, 1841; Smith, *Cat. Hymen. Brit. Mus.*, II, 1854; Cresson's descriptions in the *Trans. Amer. Ent.*

¹ Contribution from the Entomological Laboratory, Massachusetts Agricultural College.

Soc. and the Proc. Ent. Soc. of Philadelphia; Smith, Monograph of the Genus *Xylocopa*, Trans. Ent. Soc. London, 1874; Taschenberg, Zeitschrift für den Gesamten Naturwissenschaften, 1879; Pérez, Contribution a L'Etude Des Xylocopes, Act. Soc. Bordeaux, LVI, 1901; and Maidl, Die Xylocopen des Wiener Hofmuseums, 1912, Annalen Naturhistorischen Hofmuseums.

For the loan of material through Dr. H. T. Fernald, for the privilege of study at the several museums named, and for counsel and suggestions given at various times, the writer wishes to express his gratitude and appreciation to Dr. H. Skinner and E. T. Cresson, Jr., of the American Entomological Society at Philadelphia, to Mr. J. C. Crawford, of the U. S. National Museum, to Mr. Samuel Henshaw, of the Museum of Comparative Zoölogy at Harvard University, to Mr. Charles Schaeffer, of the Brooklyn Museum, to Mr. George P. Engelhardt, of the Children's Museum of Brooklyn, and to Dr. Henry Franklin, of Amherst, Massachusetts.

At this point I desire to express my sincere thanks to Dr. H. T. Fernald for his friendly guidance and encouragement and for his many helpful suggestions in this work. To Dr. G. C. Crampton I also wish to acknowledge my appreciation of his willing aid at all times.

HISTORY.

The earlier writers included species of *Xylocopa* under various genera. Linné, Fabricius and others described many species which belong to *Xylocopa* under the genus *Apis*. Fabricius, Illiger and Lepeletier placed some species under *Bombus*; Jurine under *Bremis* and *Trachusa*; Westwood under *Centris*; Lepeletier under *Lestis*; and Klug under *Megilla*.

The genus *Xylocopa* was established by Latreille in 1802 and he included under it three species, *Apis violacea* Fabr.; *morio* Fabr.; and *brasilianorum* Fabr. Which one of these three species was the type of the genus he failed to designate.

In 1838 Westwood proposed as a connecting link between *Anthophora* and *Xylocopa* a new genus, *Mesotrichia*, which resembled *Xylocopa* because of its habitat and *Anthophora* because of its extraordinary formation of the intermediate legs, and describes one species, *M. torrida*. Again in 1840 Westwood split *Xylocopa*, forming

the new genus *Platinopoda*, characterized by the anterior tarsi being dilated.

In 1841 Lepeletier proposed two subgenera of *Xylocopa*, *Andinetia* and *Schönherria*, his *Andinetia* corresponding to *Platinopoda* of Westwood. *Schönherria* was called a subgenus because the scutellum of the females was inclined and not elevated on its hind margin. Smith, in his Monograph of the genus *Xylocopa*, did not recognize the subgenera of Lepeletier but divided the genus into geographical regions. In 1894 Gribodo tried to form a new subgenus, called *Koptorthosoma*, because of a truncate scutellum. Pérez and Maidl, in 1901 and 1912 respectively, divided the genus geographically as Smith had earlier done.

Too many species have been recorded as occurring in the United States. Of the fifteen species collected or reported from this country I feel certain that only nine are distinct, while the remainder are synonyms or subspecies.

HABITS.

Since the writer has had no opportunity of studying the habits of these insects, such information will be taken from the best articles on the subject available at the present writing.

Ashmead in *Psyche*, Vol. VII, pp. 23-25, gives the following on the habits of *Xylocopa*:

"The genus *Xylocopa* comprises some of the largest bees known, many of which closely resemble the bumble-bees. From their method of boring in posts and rafters, in which they construct their nests, they are known as carpenter-bees. The most common species in the United States is *Xylocopa virginica* Linné. I have frequently found their nests made in the railings of a porch, in posts, rafters, doors, palings of fences, door frames, window sills, etc.

"The species bores a cylindrical hole, about one half inch in diameter, until the depth of ten, twelve or more inches is attained. At the bottom of this long tunnel or gallery, the female now deposits a ball of pollen-paste in which she lays a single egg. This is then carefully covered over with a thin partition formed of sawdust and a glutinous substance or secretion, and this constitutes the first cell. Upon this another ball of pollen-paste and an egg is laid and again enclosed by a partition, and so on until a series of cells, one above another, is formed and the tunnel is filled. The imagos hatch out

in July and August and hibernate in the middle states during the winter months."

Westwood, in his *Classification of Insects*, Vol. II, p. 278, says that the bees form about a dozen cells, one above another, in one tunnel. When the larvæ in these cells are full grown they assume the pupa state, head downward, so as to allow the lowermost and oldest to make its way out of the bottom of the burrow as soon as it becomes winged, and which consequently takes place earlier than in those which occupy the upper cells.

Davidson in *Entomological News*, 1893, p. 151, gives an article on observations of *Xylocopa orpifex* in southern California. In opposition to Westwood's statement he notes that the bees, after hatching, all make their exit through the original opening; thus the bees in the top cells come out first, while those in the lower cells, which are the older, make their exit last. He suggests, as the reason for this, that the bees in the upper cells are all males, while those in the lower cells are all females.

L. O. Howard, in *Proc. of Ent. Soc. of Washington*, Vol. II, p. 331, gives an article on hibernation of the carpenter-bees. He states therein that the male as well as the female does hibernate. Previously it had been thought that the male does not winter over.

EXTERNAL ANATOMY.

Head.—The head, which is hypognathous, is relatively large as compared with the thorax. It is broad and usually rather thick, and viewed from the front its form is subcircular in outline. Its size varies somewhat but as a rule is wider and thicker in the female. The face is usually slightly convex in profile and here the punctuation is most dense, while that on the vertex and cheeks is rather sparse. The face generally bears but few short hairs, while the pilosity on the cheeks, especially the lower half, is long and dense.

The vertex is bounded posteriorly by the occiput and anteriorly by an imaginary transverse line between the antennal pits. The vertex in the males is narrowed toward the occiput and is likewise narrowed on the front surface because of the marked approximation of the eyes. In the lower portion of the vertex there is a pit which surrounds the middle ocellus and is continuous with a median groove on its lower margin. This median groove passes downward to the

frontal carina, which is located between the antennal pits or just a little above them. The frontal carina is a protuberance of varying form, bluntly ridged in some species, sharply ridged in others, and even entirely absent in some cases.

The frons extends from the vertex to the upper margin of the clypeus and with a triangular prolongation on each side extending downward between the clypeus and the eye to the base of the mandible. The area between the bases of the antennæ and the central part of the dorsal margin of the clypeus is called the frontal shield. The longitudinal grooves extending downward on each side from the base of the antennæ and ending in a pit halfway down the sides of the clypeus are termed frontal grooves in this paper, and the pits are termed lateral foveolæ.

The clypeus is a trapezoidal, more or less flattened plate occupying the lower front portion of the head. It is marked off from the frons by strong sutures, or sometimes by elevated ridges along its upper margin. Along its lower margin it bears the labrum. This margin is quite straight and transverse, its outer fourth, however, turning rather sharply upward and outward toward the eye. The sides of the clypeus curve downward toward the base of the eye. In the male it is more regularly trapezoidal in form, while in the female its inferior half is usually much wider. The smooth impunctate area between the base of the mandible and the lower part of the eye is probably formed by a posterior extension of the frons and an anterior extension of the gena. This area may be called the malar space.

The labrum is attached to the lower margin of the clypeus but slightly behind the outer surface of this margin, and varies in form in different species as well as in the sexes of the same species, sometimes appearing one-lobed, sometimes two-lobed, sometimes three-lobed. The general form of the labrum is triangular or trapeziform and it extends downward in approximately the same plane as the clypeus.

The genæ or cheeks are the sides of the head behind the eyes. There is no line of demarcation between the genæ and the occiput, or between the genæ and the vertex. They are widest along the upper half, gradually narrowing toward the mandibles.

The antennæ are situated on the frons opposite the middle of the eyes. The distance between their insertions is equal to that between

the insertions and the margin of the eyes, in the females; in males, however, the distance between the insertions is greater than that to the eyes. The bulb is quite different in appearance from the remainder of the scape. The scape or first antennal segment is by far the longest segment of the antenna and is slightly widened at both ends. The next joint to the scape is the pedicel, which is the shortest segment of the antenna. The flagellum or whip of the antenna is made up of ten segments in the female and eleven in the male. The first joint of the flagellum is always the longest and is narrowed toward its base. The form of the antenna is cylindrical and it is often finely pubescent.

The mandibles of the female are large and powerful; they are widest at the base and gradually narrow toward the apex. In some specimens there is a distinct emargination on the upper side; also there is some variation in the number of teeth. In all females they are bidentate at the apex but some have one and some two additional blunt teeth on the upper margin. The mandibles are more uniform in the male, always being two-toothed at the apex and without teeth on the upper margin. The front tooth is the smaller and not as pointed as the hind one. The mandibles of the male are smaller and considerably less powerful than those of the female. In both sexes the mandibles bear but few punctures; there is often a depressed area at the base. They are marked by a prominent longitudinal groove extending along the upper margin and a faint one along the lower margin with a ridge between them.

The compound eyes are large and oval in form with well rounded ends and protrude considerably from the head. In the males they are as a rule larger than in the females and often occupy two-thirds of the frontal area. They are also approximated on the summit of the head, so that the distance between them is less above than below. The color of the eyes is lighter than the general color of the body, except in fulvous males where it is darker.

The ocelli, three in number, form a triangle on the vertex. In some species the hind ocelli are a very short distance behind the median one. The posterior ocelli in many species are carinated in front, thus causing them to appear sunken behind; this condition occurs more often in the females than in the opposite sex. There is also a pit or indentation behind each of the posterior ocelli in many

species, these indentations being called ocellar pits. In males of those species in which the compound eyes converge above, the hind ocelli touch the inner margin of the eyes. The color of the ocelli is darker than that of the eyes; it is sometimes black but more often brown.

THORAX.

The thorax, as in most Hymenoptera, in addition to the three thoracic segments of other insects, includes the propodeum or first abdominal segment.

Prothorax.—The pronotum is firmly attached to the anterior margin of the mesonotum. Laterally it is prolonged in the form of a lobe, the pronotal lobe, which extends backward nearly to the mesothoracic epimeron. There is an oblique groove extending from the front of the notum to the base of the pronotal lobe, which divides the former into an upper and two lower plates, one on either side of the body. Between these two plates lies a pair of sclerites on the ventral surface approximated along the median ventral line and usually called the prosterum, though really constituting the propleuron. In this paper the usual name, though morphologically inaccurate, is retained for convenience.

The lower lateral plate of the pronotum, which is usually termed the propleuron, extends downward on each side from the base of the pronotum and pronotal lobe and becomes greatly narrowed ventrally. The pronotum is slightly concave on each side. The sternum of this segment has become reduced almost to nothing, only a trace of it remaining close to the fore coxæ.

Mesonothorax.—The mesonotum consists of two plates, the scutum and the scutellum. The scutum is the very large anterior plate which extends from the posterior margin of the pronotum back to a point over the middle of the hind wing. It is quite convex, especially in front, where its antero-lateral angles extend downward to the pronotal lobes. Running backward from the anterior margin of the scutum is a faint median suture which becomes obliterated at about halfway to the posterior margin. A short distance from this line and extending parallel to it are two short sutures, one on either side, the parapsidal furrows. On the middle of the plate is a large, shining, impunctate area without pilosity, which in some species extends back even to the middle of the scutellum. This is known as the disk

or glabellum of some authors. The mesonotum is slightly wider anteriorly and its surface, except on the disk, is usually densely and finely punctate with varying amounts of pilosity. The front margin is slightly convex. The lateral margin is emarginate to a point behind the tegula, then turns outward and downward slightly. Here a sharp angle separates the dorsal surface of this plate from a nearly vertical portion which extends backward to the anterior margin of the side of the scutellum and largely concealed by the fore wing. The posterior margin usually is quite straight.

The scutellum, situated directly behind the scutum, is separated from it by a distinct suture. Its surface is somewhat variable, being either well rounded or flattened above and turning downward sharply behind. Its front margin above is transverse but at the sides extends forward, while the hind margin is curved backward more or less. Along the lateral forward extensions is a small, somewhat fused plate on each side, which occupies the anterior half and terminates at the front wing process. The scutellum is densely punctured except on the anterior median surface and its pilosity corresponds to the number of punctures.

The mesopleuron is made up of the epimeron and the episternum. The former is composed of two plates, the anterior, smaller one being situated a little above the posterior, and lying just above and behind the pronotal lobe at the base of and partly concealed by the tegula. Along the lower margin of the posterior plate is a well marked suture which separates it from the episternum and which terminates just above the middle of the anterior margin of the pleural plate of the metanotum. The episternum is the very large lower plate of the mesopleuron. It is convex, densely punctured and pilose. Below, it is fused with the mesosternum with no suture between to show the limits of each. The mesosternal portion is concave with a slight longitudinal suture extending along the median line.

The post-scutellum, as shown by Snodgrass in his excellent work on the thorax of Hymenoptera (Proc. of U. S. Nat. Mus., Vol. 39, p. 53, 1910) is entirely concealed within the body between the mesothorax and the metathorax. However, since systematists generally apply post-scutellum to the true metanotum, I shall use this practice in the present paper so as to prevent confusion.

Metathorax.—This segment is very small and compressed, lying

between the mesothorax and the propodeum or first abdominal segment. The true metanotum (here called the post-scutellum) is a very narrow transverse plate, slightly wider in the middle than at each side where there is a wide lateral plate extending forward to the hind wing. The metanotum is rather well punctured and pilose. The metapleuron consists of two plates, the upper larger one extending from the base of the hind wing to the mesocoxa, being situated somewhat anterior to the lower one which is small and bears the hind leg. The upper plate is elongate and oblong, the upper portion being wider than the lower one. In front it articulates with the lower plate of the epimeron and below this with the posterior margin of the episternum. Its hinder margin articulates with the propodeum. The lower plate is very small and is triangular in form. The anterior extension of the triangle passes between the propodeum and the middle coxa to the lower end of the upper metapleural plate; the lower one passes between the middle and hind coxa and fuses with the metasternum; the third passes backward for a short distance between the hind coxa and the propodeum. The metasternum is a small trapezoidal plate whose anterior portion is convex and posterior portion concave.

The propodeum is the true first abdominal segment and it bears a spiracle on each side. The spiracles are elongate and curved anteriorly. The propodeum consists of a notal plate which has become firmly joined to the metathorax while its ventral plate has been entirely lost. It is divided into a median area and two lateral ones by two fine, curved ridges which meet on the lower margin. The median area has a median longitudinal ridge extending from its upper to its lower margin. The lateral areas are large and a little depressed about the spiracles. There are few punctures on the median area though there may be considerable pilosity on the sides.

ABDOMEN.

The number of segments of the abdomen is six in the female and seven above in the male (not counting the propodeum as an abdominal segment). The abdomen is well punctured and pilose, especially along the sides.

The dorsal sclerite of the so-called first segment is much the largest. Its large triangular anterior face extends downward and

overlaps the small ventral sclerite on each side. The anterior face presents a large, median, concave area, the excavation being widest at its lower end. The punctation of the dorsal surface of this segment is finer and denser than on any of those that follow, while the pilosity is rather thick and often is present as a tuft on either side.

On the dorsal surface of segments two to five inclusive the punctation is quite well marked and dense, especially along the sides. The dorsal surface, however, is naked and shining in many species though in others there may be a little pubescence present, which is most noticeable along the hind margin of the segments. Each segment consists of a dorsal and a ventral sclerite, the former overlapping the latter on each side. The last segment of the female is more pointed than that of the male and the sides of the dorsal sclerite overlap the ventral sclerite as in the preceding segments. On the dorsal surface of the female are two rows of short spines which converge toward the apex. These are called the epipygium in this paper.

In the male the last dorsal sclerite (the seventh) overlaps the sixth sternal plate, since in this sex there are only six sternal sclerites while there are seven dorsal ones. A pair of styli or cercus-like pieces, known as penicilli, occur at the tip of the last visible dorsal plate among males of two species, *orpifex* and *tabaniformis*. The pilosity of the last segment is caused by long and dense hairs, a fact frequently made use of in classification. A slight median longitudinal carina often occurs in the dorsal and ventral plates of the entire abdomen.

Sting.—This organ is situated in a cavity at the end of the abdomen and is a tapering shaft which is directed backward. It consists of three plates, a dorsal one and two ventral ones. The dorsal plate is called the sheath and forms the upper and side areas of the sting; its greatly swollen basal portion is termed the bulb. Ventrally at the base of the bulb are two lateral arms which curve inward and upward to form the ventral plates of the shaft. These arms are called the lancets or darts which slide along tracklike grooves found on the ventral edges of the dorsal plate.

Between the lancets two poison glands empty into the bulb. Within the bulb and running the length of the shaft is the sting canal which receives the poisonous secretions. The distal ends of the lancets are barbed on either side. Surrounding the base of the shaft

are paired plates which are connected with the base of the lancets by a triangular plate. These paired plates overlap the bulb and at the distal ends of the inner pair are borne the elongate palpus-like appendages which enclose the sting. Minute branched hairs are found on the posterior ends of these palpi which are probably tactile.

Male Genitalia.—The male genitalia are attached to the abdomen by the cardo. This sclerite forms the basal portion and is connected with the stipes on each side dorso-laterally. The stipe is a large lateral plate, the two being usually called the claspers; at the end are two lobes, the outer one usually bearing hairs, known as the lacinia and squama. These are usually fused together in this genus. The stipes extend backward dorsally, laterally and ventrally to form the greater bulk of the genitalia. Included within the extremities of the stipes are a pair of organs called the sagittæ. Their distal portions form the greatly recurved head, while the long basal part forms the shaft. Between the sagittæ is a foliaceous sclerite called the spatha.

Wings.—The wings of the carpenter-bee are large and powerful. They vary from hyaline to fuliginous with dark shades of blue, violet and green. A large arched plate, the tegula, slopes over the base of the front wing. Cresson's terminology for the venation is adopted in the present paper.

Front Wings.—The vein situated at the anterior margin is the costa. About half way along this margin is a weakly pigmented area known as the stigma. The vein just behind the costa and ending in the stigma is the subcosta. The cell included between the costa and subcosta, and terminating at the stigma, is the costal cell. The radial or marginal cell extends from the stigma and is rather sharply pointed at its outer end. The lower margin of this cell is bounded by the radius. Behind the costal cell is the median cell whose lower margin is the median and whose outer margin is the basal vein.

There are three closed and one open cell just behind the radius extending from the stigma to the outer margin. These are the first, second and third submarginal or cubital cells counting outward from the stigma. Their hinder margins are formed by the cubitus, while their outer margins are formed by the first, second and third transverso-cubital veins. The third submarginal cell is about equal in size to one and two together. Behind the submarginal cells one and two is the large first discoidal cell. The hinder margin of this

cell is formed by the discoidal vein, while its outer margin is formed by the first recurrent nervure.

At the base of the wing just behind the median cell is the submedian cell whose hinder margin is the anal vein and whose outer margin is the transverso-medial vein. Beyond this cell and just behind the first discoidal is the second discoidal cell, the outer margin of which is the second recurrent nervure, and the hinder margin the subdiscoidal vein. The large, elongated lower basal cell is the anal cell. Behind the open fourth submarginal cell are two large open cells partially separated by veins and known as the first and second apical cells. On the hinder margin of the fore wing at the end of the anal cell is a broad notch known as the sinus.

Hind Wings.—In the hind wings there are only three closed cells; all are basal in position and elongate in form. The anterior one, called the costal cell, is very narrow. It is bordered in front by the costa and behind by the subcosta. The median cell is bordered in front by the subcostal vein, the stigma and the radial; behind by the media, part of the discoidal and the cubital; and distally by the first transverso-cubital vein. It is the largest cell, being very elongate and tapering at both ends.

The submedian cell is bordered distally by the transverso-medial vein and behind by the anal vein. The radial cell is open and is separated from the median cell by the radius. The first submarginal, the first and second discoidal, and the anal cells are all open. On the anterior margin of the hind wing, just beyond the stigma, is a row of frenal hooks or spinulæ which hook into the frenal fold in the posterior region of the fore wing, thus holding the two together. A slight sinus is present on the hind margin.

Legs.—The legs are long and moderately stout, the posterior pair being slightly longer than the others. The tibiæ are the only segments of the legs which bear spines; these are located on the distal portion of the inner surfaces. There is one spine present on each tibia of the male, while in the female there is one on each fore and middle and two on each hind tibia. The spines on the fore tibia which fit into a semi-circular indentation on the first segment of each fore tarsus form the antennal comb or cleaner. On the outer surface about half way down on the posterior tibia of the female is an excrescence which is called the tibial scale in this paper. It is a

surface whose irregular surrounding edge is well raised above the plane of the segment and bears two teeth at its lower extremity. The tibial scale is also present in the male but is very small and barely perceptible. The coxæ are large, subcylindrical and closely articulated with the body. The trochanters are small at their base but increase in size at their distal ends; they arise dorso-apically from the coxæ. All the femora are large and are stoutest at the base, tapering toward the outer end. The tibiæ are shorter than the femora and are rather uniform in size throughout; their inner surfaces are flattened or even concave. The tarsi are composed of five segments, the first being much longer than the other four together. The last segment bears a pair of curved bi-cleft claws between which is a pulvillus.

All the segments of the legs bear more or less hair, though it is longest and densest on the femur, tibia and first joint of the tarsus. The hind tibiæ and tarsi of the females are especially well adapted for collecting pollen because of their very long, dense hairs.

SECONDARY SEXUAL DISTINCTIONS.

There are several sexual distinctions, besides the copulatory armature in the males and the sting in the females, as follows:

1. The antennæ of the female have twelve segments, while the antennæ of the male have thirteen.
2. The posterior tibia in the female has two spines, while in the male there is only one present.
3. The female has six exposed abdominal segments, while the male has seven above.
4. There is a triangular row of spines on the dorsal side of the last abdominal segment in the female, not present in the male.
5. The mandibles of the male are always two-toothed and more narrowed than in the female.
6. The frons of the male of many species is yellow while that of the female is always dark.
7. The males of some species are entirely yellow while the females are dark.
8. The tibial scale is very large and prominent in the female while it is barely perceptible in the male.

DESCRIPTIONS.

The lists of references for this genus by Dalla Torre in his Catalogue Hymenopterorum, Vol. X, are so full in most cases that it has seemed unnecessary to give complete lists. However, all references of literature known to me since Dalla Torre will be given, thereby making the list as complete as possible.

SYNONYMY.

Synonyms.	Correct Names.
<i>amblardi</i> Pérez	<i>californica</i> Cress.
<i>purpurea</i> Cresson	<i>micans</i> Lep.
<i>binotata</i> Pérez?	<i>barbata</i> Fab.
<i>binotata</i> Maidl	<i>micans</i> Lep.
<i>varipuncta</i> Patt.	<i>mordax</i> Smith.
<i>morio</i> Cress.?	<i>mordax</i> Smith.
<i>transitoria</i> Pérez	<i>brasilianorum</i> Linné.
<i>ordinaria</i> Smith	<i>brasilianorum</i> Linné.
<i>virescens</i> Smith	<i>brasilianorum</i> Linné.
<i>cubæcola</i> Lucas	<i>brasilianorum</i> Linné.
<i>mordax</i> Smith	<i>brasilianorum</i> Linné.
<i>æcipennis</i> DeGeer	<i>brasilianorum</i> Linné.
<i>varipuncta</i> Patt.	<i>brasilianorum</i> Linné.

TABLE OF SPECIES.

- Twelve antennal segments, six dorsal abdominal segments; females.....1
- Thirteen antennal segments, seven dorsal abdominal segments; males...12
- 1. Hairs of the abdomen entirely black2
- Hairs of the abdomen not entirely black8
- 2. Wings fuliginous or fusco-hyaline.....3
- Wings sub-hyaline **orpifex** Smith
- 3. Mandibles with two teeth at the apex and one on middle of inner margin, integument black4
- Mandibles with two teeth at the apex and none on inner margin, integument deep blue **arizonensis** Cress.
- 4. Posterior ocelli with a large carina in front..... **fimbriata** Fabr.
- Posterior ocelli without a carina in front.....5
- 5. Wings fuliginous, scutellum rounded behind6
- Wings semi-hyaline, scutellum truncate behind7
- 6. Wings with violet color predominant, tints of blue and purple apparent
brasilianorum brasilianorum Linné.
brasilianorum varipuncta (Patt.)

Xylocopa orpifex Smith.

Xylocopa orpifex Smith, Trans. Ent. Soc. London, p. 298, n. 118, ♀, ♂, 1874.

Xylocopa orpifex Davidson, Ent. News, p. 151, 1893.

Xylocopa orpifex Ashmead, Psyche, Vol. VII, p. 24, 1894.

Xylocopa orpifex Fowler, Rept. Cal. Exp. Sta., p. 318, 1898-1901.

Xylocopa orpifex Pérez, Act. Soc. Bordeaux, LVI, p. 122, 1901.

Xylocopa orpifex Cockerell, South Cal. Acad. Nat. Sc., No. 6, p. 87, June, 1904.

Xylocopa orpifex Maidl, Ann. Nat. Hist. Hof.-Mus. Wien, p. 309, 1912.

A small black insect; length of female, 17-20 mm.; of male, 15-18 mm.

Female.—Head and its hairs entirely black; broad, almost as wide as thorax, and thick; the mandibles dark, with three teeth, being bidentate at the apex and with a small tooth on the inner margin along which extends a deep longitudinal groove; the few hairs present on the mandibles are reddish brown, as is the case among most of the species; labrum small and black, consisting of one lobe somewhat triangular shaped with the upper margin elongate and a small lobe on either side hidden beneath; clypeus flat, with a smooth, shining, unpunctured space along the lower margin, the rest with small, close punctures, longitudinal carina not present; lateral foveolæ not very deep; frontal shield on same plane as clypeus, well punctured; frontal carina small and pointed, having a pit on the upper surface half way to the median ocellus, where it forms a heart-shaped groove reaching and surrounding the median ocellus; prominent ocellar pits present, situated dorso-laterally behind the posterior ocelli; eyes not large, far apart; antennæ piceous on under side of flagellum; vertex and cheeks with fewer punctures than on face, hairs black.

Thorax black, hairs black; disk black, shining, smooth and without hairs; scutellum well rounded, with few punctures, especially in its anterior half; post-scutellum very narrow and rather impunctate.

Color of integument and pile of abdomen everywhere black; punctation not close except on last segment where it is very fine and abundant; abdomen very short and robust; epipygium not wide at base, its spines very strong.

Wings subhyaline with a very slight violet tint, and a little darkened at their apices. Tegulæ black.

Legs black, their pile black except on inner tarsi where it is mixed with reddish brown. Anterior tooth of tibial scale very pointed, posterior tooth greatly rounded.

Male.—Differs from the female as follows: Head with yellow color at the base of the mandibles, on labrum, clypeus, frontal shield, and more or less of the areas between the clypeus and eyes; yellowish-white hairs on cheeks, vertex, and some on the face; head not as wide as in female and face much narrower; mandibles narrowed with only two teeth present; labrum much larger; clypeus a little convex, with longitudinal carina perceptible and impunctate; ocellar pits much smaller and rather inconspicuous; eyes much larger, vertex flatter. Thorax with a great abundance of dense yellowish-white hair, mixed with black, on the back and sides. Sides of abdominal segments more closely punctuated. Tibial scale much smaller and of only one lobe. A pair of cercus-like pieces (penicilli) are present on the tip of the seventh dorsal segment.

Type.—Probably in the British Museum.

Distribution.—California, Arizona, Oregon, Nevada.

This species can easily be distinguished from other species of the United States. Dr. L. O. Howard, in *The Insect Book*, figures *Xylocopa orpifex* on plate II, fig. 26.

Xylocopa micans Lep.

?*Apis nasuta* Christ, *Naturg. d. Insect*, p. 130, T. 8, F. 5, 1791.

Xylocopa micans Lepeletier, *Hist. Nat. Insect. Hymén.*, II, p. 208, n. 58, ♂, 1841.

Xylocopa vidua Lepeletier, *Hist. Nat. Insect. Hymén.*, II, p. 210, n. 61, ♀, 1841.

Xylocopa purpurea Cresson, *Trans. Am. Ent. Soc.*, IV, p. 284, ♀, 1872.

?*Xylocopa purpurea* Smith, *Trans. Ent. Soc. London*, p. 299, n. 121, ♀, 1874.

Xylocopa micans Patton, *Can. Ent.*, XI, p. 60, 1879.

Xylocopa micans Maidl, *Ann. Nat. Hist. Hof.-Mus. Wien*, p. 309, 1912.

Xylocopa binotata Maidl, *Ann. Nat. Hist. Hof.-Mus. Wien*, p. 310 (nec. Pérez), 1912.

Length of female, 15–18 mm.; of male, 20–22 mm.

Female.—Head almost as wide as thorax, black with deep blue and purple reflections, especially on the vertex and cheeks; punctures of face small, fine and close; grayish white hairs intermingled with some black occur on clypeus, lateral areas of frons between the clypeus and eyes, between the bases of antennæ, and on the cheeks; mandibles with four teeth, two large ones at the apex and two small ones on the upper margin, which are often worn off; color of mandibles black with a green spot at the base in many; labrum small and black, consisting of one triangular lobe whose upper margin is very elongate, and a small one on each side but hidden below; clypeus flat, greenish

blue, well punctured, with a black, shining, impunctate space along the lower margin; longitudinal carina not present; frontal shield on same plane as clypeus, sides sloping, of a greenish blue color; frontal carina small and pointed, upper margin flat for a distance, then changing into a furrow which is concurrent with the groove surrounding the median ocellus; posterior ocelli slightly carinated in front, causing them to appear a little sunken behind, and midway between them is a short furrow extending from the median ocellar groove; small circular ocellar pits occur behind the posterior ocelli; under side of flagellum of antennæ piceous, otherwise black; eyes rather small and far apart; vertex somewhat raised on top just behind the ocelli and sparsely punctured; cheeks also sparsely punctured.

Thorax black on disk, otherwise blue and purple, well punctured; hairs black, with some pale ochraceous ones on the scutellum and post-scutellum and a small patch on each side just below the tegulæ; scutellum rounded and well punctured; post-scutellum very narrow.

Abdomen brilliant bluish purple; punctures small, fine and close, especially on the first and second segments; a patch of white hairs on the sides of segments one, five and six, and a few white ones on sides of the intervening segments; otherwise black; epipygium very narrow at the base, spines rugged.

Wings fusco-hyaline with a violet tint, darker at the apical margins; tegulæ blue.

Legs bluish purple, pilosity black except some brown on the inner surface of the fore tarsi. Tibial scale small, the anterior tooth being long and pointed, the posterior one very short and rounded.

Male.—Differs as follows: Head with yellow color on labrum, clypeus, frontal shield and lateral areas of frons between the clypeus and eyes as high as the insertion of the antennæ, and on the lower side of the first segment of the antennæ; whitish-yellow hairs on the face, vertex and cheeks; head not as wide as in female, face much narrower, especially in its upper half; mandibles narrower, convex along the middle, only two teeth present, the lower one being much the larger, dark brown with a slight yellow spot appearing at the base in some specimens; labrum larger; clypeus somewhat convex; an unpunctured longitudinal carina evident; a shallow furrow behind each posterior ocellus extending backward for a short distance and ending abruptly on the vertex; eyes much larger and converging strongly above, producing a very narrow vertex.

Thorax everywhere covered with dense whitish-yellow hair; integument with some green color, otherwise as in female. Abdomen green on first two segments, then changing to a blue color, and to a brilliant purple on the apical segments; ventral segments bluish purple mixed with more or less orange toward the middle; pilosity whitish-yellow on whole of first segment, a little on sides of all segments but the last, and a fringe on the hind margin of all the ventral segments except the apical segment; apical segment with a very thick brush of long, black hair. Wings a little lighter than in female; tegulæ brown.

Hair of legs not entirely black as in female, but with some whitish-yellow on fore tibiæ and tarsi, on middle and hind coxæ, trochanters, femora, tibiæ, and on the outer upper half of the first segment of tarsi; tibial scale much smaller and consisting of but one lobe.

Type.—Probably lost.

Distribution.—Florida, Georgia, North Carolina, Texas, California, Guatemala.

I have examined Cresson's type of *Xylocopa purpurca* at the American Entomological Society at Philadelphia and am convinced that it is *micans* Lep. Cresson's description was made from specimens from Texas, there being a series of four female specimens present, three from Texas and one from California, of which one from Texas is labeled lecto-type, and another from Texas is labeled para-type. Lepeletier's description was made from specimens collected in Carolina.

According to Cresson's description of *purpurca* there might be a distinction between it and *micans*. He described a tuft of white pubescence on each side of the apex of the abdomen only, while *micans* has a tuft of white on each side of the first segment in addition. Upon examining the type *purpurca*, however, I found the tuft of white hair on each side of the first segment and therefore know of no reason why *purpurca* is not a synonym of *micans*.

Male specimens of *micans* collected in Texas also agree in every way with the description of *micans* made by Lepeletier of the male from Carolina.

Micans has also been confused somewhat with *texana* Cr., but these two species are very different and should be easily distinguished.

In The Insect Book, plate III, fig. 24, Dr. L. O. Howard figures a female of this species.

Peréz probably had reference to some small Central American form according to his description of *binotata*. Maidl lists three females of *binotata* Peréz from Georgia and one male from Texas, but his short description of *binotata* does not agree very well with that of Peréz. I think that the insects which Maidl calls *binotata* are probably synonymous with *micans* Lep.

Xylocopa virginica Linné.

—————Drury, Ill. Nat. Hist., I, p. 96, ♂; Pl. 43, f. 1, 1770.

Apis virginica Linné, Mantissa Plantarum, II, p. 540, 1771.

Apis virginica Drury, Ill. Nat. Hist., II, App. 1773.

Xylocopa virginica Illiger, Mag. f. Insectenk., V, p. 151, n. 19, 1806.

Xylocopa virginica Peréz, Act. Soc. Bordeaux, LVI, p. 112, ♂, ♀; 1901.

Xylocopa virginica Maidl, Annals Nat. Hist. Hof.-Mus., Wien, p. 309, 1912.

Length of female, 22 mm.; of male, 22-24 mm.

Female.—Head almost as wide as thorax, black, though a tinge of blue or green occurs in some; punctures very fine on the face, hairs black everywhere; mandibles having two teeth at their apices and none on the inner margin, large with a good-sized punctured depression at their bases; labrum with one blunt, fairly large triangular lobe; clypeus rather flat, well punctured, an unpunctured concaved area along the lower margin, the upper margin slightly incurved in the middle, longitudinal carina barely perceptible; lateral foveolæ and frontal grooves not very deep; frontal shield on same plane as clypeus but with sides sloping; frontal carina rounded and very prominent; posterior ocelli slightly carinated in front with a small circular pit behind each; antennæ black, eyes not large and widely separated; vertex and cheeks having bluish purple tints, punctures larger and fewer than on face.

Thorax black on disk, changing to blue, green and purple on sides and below; pilosity very dense, whitish yellow on top except the disk and on sides, black below; scutellum olive green; post-scutellum sparsely punctured.

Abdomen black, showing green on the first segment; punctures small and few except on first segment which is well punctured; whitish yellow hairs occur only on the first segment, elsewhere they are black; epipygium very large, spines small.

Wings fusco-hyaline with a violet tint, darker at the apex, tegulæ brown or black.

Legs black, blue and purple; hairs black, brown on inner side of fore tarsi. Tibial scale with edges well raised so that interior appears hollowed out; anterior tooth very sharp, posterior one more rounded or even blunt and not as long as anterior one; form longer than wide.

Male.—Differs from the female as follows: Head, labrum, clypeus, frontal shield and lateral areas of frons between clypeus and eyes as high as the insertion of the antennæ, yellow; yellow hair present only on yellow colored areas of head, otherwise black; head not as wide as in female, face more narrowed, especially above; mandibles smaller than in female; labrum larger; clypeus slightly convex, lower marginal area not concaved; frontal carina smaller; eyes much larger and converging above, thus forming a much narrower vertex; ocellar pits imperceptible. Punctures of abdomen more abundant throughout, much finer and closer. Yellowish brown hair present on fore and middle tibiæ; tibial scale greatly reduced.

Type.—Location unknown to the writer.

Distribution.—This species is distributed generally throughout the United States and is also recorded from Cuba. It is the most common species of *Xylocopa* found in this country.

Variation.—A male specimen collected at Chapel Hill, Texas, differs from the typical male described above as follows: Face entirely black except a yellow area along the longitudinal carina of the clypeus, and yellow present on the labrum.

Drury described and figured this species (Ill. Nat. Hist., I, p. 96, Pl. 43, f. 1, male, 1770) without a name in 1770. During the following year (Mant. Plant. II) Linnæus gave the name *Apis virginica* to this insect. Drury (Ill. Nat. Hist., II, 1773) furnished an appendix of names covering his descriptions in volumes I and II. In 1806 Illiger placed this species in the genus *Xylocopa* for the first time, calling it *Xylocopa virginica*.

***Xylocopa texana* Cresson.**

Xylocopa texana Cresson, Trans. Am. Ent. Soc., IV, p. 283, ♀, ♂, 1872.

Length of male and female, 22–24 mm.

Female.—Head about as wide as thorax, black, showing bluish purple in different lights; punctures abundant and fine especially on the face; hairs black; a large punctured depression at the base of

the mandibles, whose teeth are two in number, located at the apex; labrum consisting of one blunt lobe, rather large and triangular in shape; clypeus well punctured, a little convex in its superior half, a deeply concaved, shining, impunctate area along its lower margin, which is dark red in many specimens, the longitudinal carina barely evident; lateral foveolæ and frontal grooves very deep and prominent; frontal shield iridescent, very convex; its sides sloping greatly; frontal carina very large and blunt (more prominent than in *virginica*), so that the median ocellus appears sunken, posterior ocelli carinated in front, a small circular pit behind each; antennæ black, eyes not large, widely separated; vertex and cheeks with a strong, bluish purple color, punctures larger and fewer on face, hairs entirely dark.

Thorax black on disk, changing to blue, green and purple on sides and beneath; pilosity very dense, yellowish white on top, except the disk and on sides, black below; scutellum blue to green, well punctured; post-scutellum small and little punctate.

Abdomen elongate, olive green with blue reflections; punctuation fine and close on first segment, otherwise sparse; yellowish white hairs on first segment, a patch of them on sides of segments five and six, and a few scattered ones on sides of intervening segments, hairs elsewhere black; epipygium very large, spines small.

Wings fusco-hyaline with a violet tint, darker at the apex, tegulæ brownish black.

Legs blue, purple, sometimes a little greenish, hairs black, brown on inner side of fore tarsi. Tibial scale with anterior tooth narrow and very pointed, posterior one wider and pointed, the two teeth of equal length; form not as elongate as in *virginica*, being almost as wide as it is long.

Malc.—Differs as follows: Head yellow on labrum, clypeus, frontal shield; in some specimens a little on the lateral areas of the frons between the clypeus and eyes as high as the insertion of the antennæ and a small spot at the base of the mandibles; color otherwise black with bluish purple on the vertex and cheeks; head not as wide as in the other sex, face more narrowed; hairs of head yellowish white on cheeks and vertex, some scattered patches on frontal shield, between insertion of antennæ and between the posterior ocelli; mandibles smaller, depression at base not so deep; labrum a little wider;

clypeus somewhat convex, area along lower margin not concaved; frontal carina much smaller; eyes much larger and approximated more or less above, producing a narrow vertex. Thorax with more yellowish white hairs than in the other sex, especially on the ventral surface where it is mixed with the black. Punctuation of abdomen much finer and closer throughout; yellowish white hairs on the hind margin dorsally of segments four and five mixed with some black, otherwise pilosity as in female. Wings a little lighter than in other sex. Tibial scale very reduced; a variable amount of yellowish hair present on legs.

Types.—Cresson's typical specimen labeled "Lecto-type 2620" "Tex" is in the Acad. Nat. Sc., Philadelphia, along with a male labeled "Allo-type 2620" "Tex" and a male and female paratype. In the collection of the Museum of Comparative Zoölogy at Harvard is a male and female labeled "Type 556" "Dallas, Tex., Boll." In the U. S. N. M. are two specimens, a male and a female, labeled "Type No. 1792, U. S. N. M.," "Collection Belfrage."

Distribution.—I have examined specimens taken at Dallas, Round Mt. and Kerrville, Texas.

This species seems to occur throughout the northern and central part of Texas but I find no record of it in any other state. It is very closely allied to *Xylocopa virginica*, which is also found in some parts of Texas, though I find no record of it (*virginica*) occurring in the same localities with *texana*. The females of *texana* and *virginica* resemble each other very much. Generally speaking, however, the predominant color of *virginica* is black, while that of *texana* is green, with some blue present. This is a rather variable character, though, for many specimens of the one species will approach those of the other very closely in color. The frontal carina of *texana* is larger and more prominent than that of any other species found in the United States. The frontal carina of *virginica* is of medium size in the specimens collected from the eastern states, but it seems to increase in size on specimens taken from Texas, although it does not attain the size and prominence that it does in *texana*. The white pile present on the sides of segments five and six, and the few scattered ones along the sides of the other segments found in *texana* do not occur in *virginica*; this seems to be a rather constant character for separating the species.

The males of *texana* and *virginica* resemble each almost as closely as do the females. The following differences, however, serve to separate the two species. The predominant color of *texana* is green, while that of *virginica* is black; *texana* has but little or no yellow coloring on the lateral downward projections of the frons between the clypeus and eyes, while in *virginica* these areas are entirely yellow; the pilosity in *texana* is yellowish white on the cheeks, vertex, face, and on the hind margins of the fourth and fifth abdominal segments, while the corresponding pilosity of *virginica* is black. I have studied the genitalia of *texana* and *virginica* and there is no doubt in my mind that they are different species.

In his Insect Book Dr. L. O. Howard gives a photograph of *texana*, male, on plate II, fig. 27. This was taken of a specimen present in the collection of the U. S. N. M., which is labeled "Type No. 1792," "From Dept. Agri."

***Xylocopa tabaniformis* Smith.**

Xylocopa tabaniformis Smith, Cat. Hymen. Brit. Mus., II, p. 362, n. 95 ♀, 1854.

Xylocopa tabaniformis var. *chiriquiensis*, Pérez, Act. Soc. Bordeaux, LVI, p. 120, ♀, ♂, n. v., 1901.

Xylocopa tabaniformis Maidl, Ann. Nat. Hist. Hof.-Mus. Wien, p. 317, ♀, ♂, 1912.

Length of female and male 17-18 mm.

Female.—Head black, hairs black, mixed with grayish-white on cheeks, hind part of vertex and face; punctation rather close and fine; mandibles with three teeth, two large ones at the apex, and one rounded small tooth on the upper margin, no depression at the base, upper longitudinal groove deep; labrum apparently of one small subtriangular lobe, but in addition one small lobe on either side hidden beneath; clypeus flat, punctures close and circular, longitudinal carina or ridge obsolete, impunctate area along lower margin not concave, upper margin straight; lateral foveolæ and frontal grooves deep and prominent; frontal shield flat in the middle, sides sloping gently; frontal carina small and pointed, the upper margin interrupted in the middle by a small pit; ocelli triangularly placed, the posterior ones with a circular pit behind each and not carinated in front; antennæ black; eyes small and rather far apart; vertex and cheeks well punctured, the whitish hairs short.

Thorax black, disk shining; hairs everywhere black, mixed with

grayish-white on the back and sides, producing a sooty aspect; scutellum wide, with few punctures, especially in its anterior half, post-scutellum very narrow.

Abdomen black and not elongate, well punctured except along the middle of the segments, finely so on the sides; pilosity dense and white on the first segment and on the hind margin of segments two, three, four and five, except in the middle, black everywhere else; epipygium narrow at the base, spines large.

Wings subhyaline, of a brassy tint, tegulae brownish black.

Legs black; hairs yellowish white on the intermediate and posterior tibiae and tarsi exteriorly, brown on the inner side of the fore tarsi, otherwise black; tibial scale small, anterior tooth very pointed and long, posterior tooth very rounded and short.

Male.—This sex differs from the female as follows: Head yellow on labrum, clypeus, frontal shield, a large spot at the base of the mandibles, and some mixed with the black on the lateral downward projections of the frons between the clypeus and the eyes; head and face narrower; mandibles smaller, with only two teeth present (at the apex); labrum with only one tooth or lobe; clypeus with fewer punctures; ocellar pits very small or even obsolete; vertex more narrowed and flattened. Thorax as in the female. Abdomen differs in having a patch of long, white hairs on the sides of segment six. A pair of cercus-like pieces (penicilli) present on the top of the seventh dorsal segment. Tibial scale not much smaller than that of the female, but with only one lobe.

Type.—Probably in the British Museum.

Distribution.—Mexico; Brownsville, Texas; Utah.

Variations.—A male from Washington Co., Utah, differs from the typical male described above by having the hairs of the head and thorax entirely white and much denser, while the white hairs of the abdomen occur only along the sides.

Xylocopa azteca Cresson is a form very similar to *tabaniformis*, and there seems to be no reliable structural character upon which the two forms can be separated. *Azteca* female differs from the female of *tabaniformis* by the presence of white pilosity on segments one, two and three of the abdomen only, but this variation between the two forms seems to be constant. The males of these two forms show even less variation; they differ as follows: the white hairs of the

abdomen in *tabaniformis* are tawny and less interrupted medially by the black hairs in *azteca*. *Azteca* could therefore be reduced to a subspecies of *tabaniformis*, but since there is no record of this form occurring in the United States I shall not include it in this paper.

Tabaniformis is primarily a neotropical species, but it also occurs in the southwestern United States. It is closely related to *orpifex*, these two species being the only *Xylocopa*s of the United States which have penicilli present on the last dorsal abdominal segment. *Tabaniformis*, however, is easily distinguished from *orpifex* by the white pilosity of the abdomen present in the former.

Xylocopa fimbriata Fabr.

Xylocopa fimbriata Fabr., Sys. Piez., p. 340, n. 7, ♀, 1804.

Xylocopa fimbriata Fowler, Rept. Cal. Exp. Sta., part II, p. 318, 1898-1901.

Xylocopa fimbriata Pérez, Act. Soc. Bordeaux, LVI, p. 81, 111, ♀, ♂, 1901.

Xylocopa fimbriata Cockerell, Southern Cal. Acad. Nat. Sciences, No. 6, p. 87, June, 1904.

Xylocopa fimbriata Maidl, Ann. Nat. Hist. Hof.-Mus. Wien, p. 311, ♀, ♂, 1912.

Length of female, 30-32 mm.; of male, 28-30 mm.

Female.—Head black, very large, as wide as thorax, face concaved in the middle, hairs everywhere black, long on the cheeks and face; mandibles with two large teeth at the apex, and one small, rounded tooth on the middle of the inner margin, no depression at the base and very few punctures present, the upper longitudinal groove very deep; labrum with three lobes; clypeus with large but few punctures, the lower marginal area irregular, having a small convex area in the middle with a large pit on each side of it, the upper margin with a well rounded elevation curved upward like a bow, the shining impunctate sides more sharply ridged and the lower extremities very prominently raised; longitudinal carina obsolete; frontal shield from the clypeus to the insertion of the antennæ flat, the superior half concaved, there being no frontal carina present; the lateral areas of the frons between the clypeus and eyes irregularly concaved and situated on a lower plane than the clypeus, so that the presence of lateral foveolæ and frontal grooves are merely marked by a suture on each side; median ocellus set in a very concaved, impunctate surface, with a short groove extending back for a little distance midway between the hind ocelli; the sides of the median ocellar area well ridged; a small concaved area behind the median

ocellus and between the posterior ones which appear sunken behind the large, prominent carinæ; these carinæ start in front of the posterior ocelli and extend transversely toward the eyes, becoming gradually elevated and ending in the form of a pair of horns; ocellar grooves situated dorso-laterally to the posterior-ocelli; above, the vertex is sparsely punctured and narrow; cheeks well punctured.

Thorax black, disk very large, shining and hairy; hairs black, short and sparse on the back and sides, longer beneath; scutellum large and little rounded, the greater part impunctate, without pile, forming the hind part of the disk, only the posterior margin pilose; post-scutellum with hair everywhere.

Abdomen black, rather long but robust, punctuation sparse except on the apical segments, hairs black, a faint carina along the middle extending the length of the tergum, and a very sharp and prominent one on the venter; epipygium not wide at the base, spines very large.

Wing opaque, the dominant color blue with tints of violet and a slightly greenish luster at the apex; tegulæ black.

Legs black, the hairs black; tibial scale well elevated, the two teeth at the apex of equal size, rather short, the anterior one a little more pointed, the posterior one striated on its posterior aspect.

Male.—Differs from the female in that it is entirely fulvous and also in the following points: Head narrow, punctuation very fine; mandibles brown with a yellow spot at their base, black toward the apex, smaller, greatly constricted along the middle, no tooth on the upper margin; labrum with only one lobe, triangular in form; clypeus flatter, the upper margin and sides not elevated; frontal shield somewhat convex, the frontal carina replaced by a short groove concurrent with the median ocellar groove; ocelli not sunken, the median one situated but little lower than the posterior ones, a very shallow circular pit behind each posterior ocellus which has no carina in front of it; antennæ fulvous on the under side throughout, reddish-brown on the upper surface which has a fine white pubescence on its flagellum; vertex and cheeks with long dense fulvous hairs.

Thorax fulvous, the scutellum much flatter, the post-scutellum very wide and more densely pilose.

Abdomen with more brown color than on the other parts of the body, the hair yellow except at the apex, where it is long and reddish. Wings semihyaline, tegulæ fulvous, covered with hairs except on the middle.

The four intermediate legs and posterior coxæ, trochanters and femora, and the two anterior coxæ, trochanters and the external surfaces of the femora are reddish black; legs otherwise yellow; the anterior and intermediate tibiæ deeply hollowed; hairs fulvous; tibial scale small and black.

Type.—Location unknown.

Distribution.—Mexico, Central America, Brazil, Peru and reported from Yosemite Valley, California.

Fimbriata is a neotropical species and the report of its occurrence in California does not seem to be authentic. It has been collected in Mexico and may possibly occur in some of the semitropical regions of the southwestern United States, and therefore I include it in this paper.

This species is one of the largest forms of *Xylocopa*. The sexes differ greatly in color. The male is entirely fulvous while the female is entirely black. This wide contrast in color of the sexes seems to be characteristic of many other neotropical species of *Xylocopa*, especially among the larger forms. The female of *fimbriata* can be easily distinguished from its closest ally *frontalis* (Ol.) by the form of the carinæ in front of the posterior ocelli. The males of these two species, however, resemble each other very closely and are not so easily separated. *Fimbriata* has been confused with *varipuncta* (Patt.) from California (which I reduce to a variety of *brasilianorum* Fabr.), but can easily be distinguished from it.

***Xylocopa Brasilianorum Brasilianorum* Linné.**

Apis brasilianorum Linné, Sys. Nat., Ed. 12^a 1, 2, p. 961, n. 449, ♂, 1767.

Apis æneipennis De Greer, Mem. hist. Insect., III, p. 573, n. 5, ♀; pl. 28, f. 8.
1773.

Xylocopa cubæcola Lucas, Sagra., Hist. fis. Cuba, VII, p. 776, ♀, pl. 19, f. 8,
1850.

Xylocopa mordax Smith, Trans. Ent. Soc. London, p. 294, n. 111, ♀, 1874.

Xylocopa varipunctata Patton, Can. Ent., XI, p. 60, ♀, 1879.

Xylocopa varipuncta Cockerell, Ent. News, 13, p. 318, 1902.

Xylocopa varipuncta Fowler, Rept. Cal. Exp. Sta., p. 318, 1890-1901.

Xylocopa varipuncta Cockerell, South. Cal. Acad. Sc., No. 6, p. 87, June, 1904.

Xylocopa brasilianorum Pérez, Act. Soc. Bordeaux LVI, p. 88, 100, ♀, ♂, 1901.

Xylocopa brasilianorum Maidl, Ann. Nat. Hist. Hof.-Mus. Wien, p. 312, ♀, ♂,
1912.

Xylocopa brasilianorum brasilianorum Linné.

Length of male, 22-24 mm.; of female, 24-26 mm.

Female.—Head black, almost as wide as thorax, well punctured, hairs black; mandibles with two large teeth at the apex and a small, rounded one on the middle of the upper margin, no depressed area at the base and with but few punctures, the upper longitudinal groove very deep with a depressed spot in the middle; labrum with three lobes, the lateral ones blunter and a little hidden beneath the hairs; clypeus flat, punctures large but few, longitudinal carina not present, the upper and lateral margins shining, impunctate, the upper margin a little elevated, the lateral ones more raised and more sharply ridged toward their lower extremities; frontal shield on a slightly higher plane than the clypeus; the frontal grooves marked by a shallow suture, the lateral foveolæ very small; frontal carina rather prominent, not sharply pointed, the upper side verging into a furrow concurrent with the heart-shaped groove of the median ocellus; ocelli small, the posterior ones not carinated in front but with large circular pits behind, a short, fine furrow midway between; eyes rather small and widely separated; vertex well punctured, the cheeks finely and sparsely so.

Thorax black, hairs black, short and not very dense on back; disk very large, including the anterior half of the scutellum, without hair or punctures and shining; scutellum behind the flat, unpunctured area rounded and sloping downward, and pilose; post-scutellum with few punctures, small and hairy.

Abdomen entirely black, hairs black, rather elongate, punctures close and fine on the anterior half, coarser on the posterior half; a longitudinal carina along the middle of the tergum, and a corresponding carina along the venter but much sharper and more prominent; epipygium not wide at the base.

Wings fuliginous, violet color predominating with tints of blue and purple; tegulæ black; length of wings 20 mm.

Legs black, hairs black; tibial scale with the anterior tooth longer, narrower and more pointed than the posterior one.

Male.—The male, besides being entirely fulvous, differs as follows: Head narrower, punctation fine; mandibles brownish black, with a yellow spot at base, constricted along the middle, smaller and no tooth present on the inner margin; labrum with only one lobe;

clypeus more convex, the upper margin and sides not elevated, longitudinal carina rounded; frontal carina very small and pointed, the upper margin faintly grooved with a pit in its middle; ocelli not sunken, close together, ocellar pits minute or obsolete, a shallow groove midway between the posterior ocelli; eyes not large and wide apart; lower side of antenna yellowish on first segment, otherwise yellowish brown, its upper side brownish black throughout and with no pubescence; vertex and cheeks with long, dense yellow hair and very fine punctures.

Thorax yellow with more or less brown, especially on the post-scutellum, propodeum and sides; hairs yellow; scutellum flat, shining, with but little hair and few punctures; post-scutellum also rather flat.

Abdomen yellow, with a brown band along the hinder margin of each segment, but this is variable as the color may become tawny in old specimens; pilosity yellow, rufous and long at the apex; finely and densely punctured throughout. Wings semihyaline; tegulae fulvous.

The fore legs from their bases to and including the basal part of the femora, and the intermediate and hind legs as far as the tibiae brownish black, otherwise yellow or fulvous; hairs everywhere yellow with a slight red tinge on the tibiae and tarsi; tibial scale very small and black.

Type.—Location unknown.

Distribution.—Texas, Arizona, Southern California, Mexico, Central and South America, West Indies.

Xylocopa brasilianorum ancipennis (DeGeer).

This form differs from the typical *brasilianorum* as follows: Female—scutellum more truncate behind; abdomen with the ventral longitudinal carina even sharper and more prominent; wings semihyaline, with a brassy luster and a violet tint on the apical margin of the anterior wings; length 22–24 mm. Male—with a dark brownish area on the middle of the clypeus; a black ring surrounding each ocellus; bands along the hind margin of the abdominal segments wider and darker colored.

Habitat.—Arizona.

Xylocopa brasilianorum cubacola (Lucas).

This form differs from *ancipennis* as follows: Female with the scutellum sharply truncate behind; ventral abdominal carina the

same; wings a little darker, a faint violet and blue color occurring throughout both anterior and posterior wings, the violet predominating. Male unknown. Length 20-22 mm.

Habitat.—California.

Xylocopa brasilianorum varipuncta (Patt.).

This subspecies is more closely related to the typical *brasilianorum* than to either of the other two described above. It differs from the other three forms as follows: Female with scutellum not truncate but rounded as in the typical *brasilianorum*; ventral abdominal carina not exceedingly prominent but as in *brasilianorum*; wings fuliginous, not as dark as in *brasilianorum*, brassy and copper colored with violet reflections. Male not known. Length 26-28 mm.

Distribution.—Arizona, Southern California.

Xylocopa brasilianorum is a species of very wide range extending from South America north into the southern United States. It is also a very variable species, as Maidl first noted in his work on the *Xylocopa* collection of the museum of Vienna in 1912. I agree with Maidl in all his conclusions in regard to variation within this species. There is no doubt that many forms have been described as new species which are merely varieties or even synonyms of *brasilianorum*. The variable characters of these forms upon which various authors have established different species are color of wings mainly, formation of the scutellum, and size. The above variable characters occur in the female, while in the male there seems to be but little variation, if any. I have studied the genitalia of a large series of insects which have been described as different species and, like Maidl, have found very little difference among them.

In this paper I include only those forms which are found in or reported from the United States; that is, the subspecies *brasilianorum*, *varipuncta*, *ancipennis*, and *cubæcola*. *Varipuncta* (Patt.) is without a doubt the same as *mordax* (Smith). In the U. S. Nat. Mus. at Washington is one of the two original female specimens of *varipuncta* with Riley's labels on it. One of the two specimens was sent to Patton and he described it as a new species, *Xylocopa varipuncta*. It is likely that Patton did not see the specimen in the U. S. Nat. Mus., and it is probable that the one from which he made his description is lost.

A representative form of the species *brasilianorum* may be found

in The Insect Book, where Howard figures *ancipennis* on plate II, fig. 25.

Among other described forms occurring within the range of *brazilianorum* which will without a doubt ultimately be recognized as subspecies of this species are *ordinaria* Smith, *morio* Cresson, *virescens* Smith, *transitoria* Pérez, and *mordax* Smith.

***Xylocopa californica* Cresson.**

Xylocopa californica Cresson, Proc. Ent. Soc. Philadelphia, III, p. 40, n. 3, ♀, 1864.

Xylocopa californica Fowler, Rept. Cal. Exp. Sta., p. 318, ♀, ♂, 1898-1901.

Xylocopa amblardi Pérez, Act. Soc. Bordeaux, LVI, p. 115, ♂, 1901.

Xylocopa californica Cockerell, South. Cal. Acad. Sc., No. 6, p. 87, June, 1904.

Xylocopa californica Cockerell, Ent. News, p. 395, var. a. ♂, 1907.

Xylocopa californica Maidl, Ann. Nat. Hist. Hof.-Mus., Wien, p. 309, ♂, 1912.

Length of female, 22-24 mm.; of male, 20-22 mm.

Female.—Head thick, almost as wide as thorax, black with blue, green and purple tints, the green color predominating; hairs black, well punctured, especially on the face; mandibles black with two teeth at the apex, base flat and having very few punctures, inner longitudinal groove not very deep, outer one very faint; labrum semi-oblong in form, emarginate in the middle, giving the appearance of two lobes, small and black; clypeus flat, very closely punctured, iridescent, longitudinal carina small and faint; lateral foveolæ of median depth, frontal groove shallow; frontal shield flat, a little concaved above, closely punctured, iridescent; frontal carina short, blunt, upper side convex; median ocellus very sunken, posterior ones well carinated in front, no ocellar pits present; eyes small, very far apart, so that the face is extremely wide; antennæ of the usual female form; vertex just behind the posterior ocelli prominently raised, green and blue colored, punctation large, coarse and abundant; cheeks blue, purple and green mixed, large but sparse punctures.

Thorax with disk large and black, color otherwise blue and green, also on sides and below; pilosity short and sparse above, black with gray mixed, entirely black and longer on sides and beneath; scutellum green, well punctured, post-scutellum narrow and well punctured.

Abdomen above olive green with some blue at the apex, venter blue with tints of green; punctation fine and sparse above, very abun-

dant below; a patch of grayish white hairs at the sides of segment one, everywhere else black; epipygium large, wide at the base, spines stout.

Wings fusco-hyaline with a strong violet tint, darkened at the apex; tegulae bluish green. Legs greenish blue, hairs black; tibial scale very prominent, both lower teeth sharp, the anterior one more narrowed, irregular above.

Malc.—Differs from the female as follows: Head smaller, not thick, face narrower, entirely dark with more green and purple; mandibles smaller, upper longitudinal groove deep, lower one more pronounced than in female, lower tooth at apex much the larger of the two; labrum with one triangular lobe, sometimes apparently trapezoidal; clypeus convex, longitudinal carina more prominent; frontal carina smaller and more pointed, upper margin flat; median ocellus less sunken, posterior ones less carinated in front; eyes much larger and converging slightly above; vertex behind posterior ocelli flat, cheeks not so thick. Thorax with the gray hairs more evident above, and present on each side below the wings, being entirely black below, only. Abdomen shorter and more robust, punctuation above much finer and closer on the first four segments, coarse but abundant on the remaining segments; pilosity grayish-white on the whole of first segment, and laterally on the hind margin of the fourth and sometimes on the third segments, otherwise black; wings a little lighter, tegulae brown, legs with tibial scale reduced to a point, inner surface of posterior tibiae with short brown hair.

Type.—In the Acad. of Nat. Sc. at Philadelphia a female labeled "Lecto-type, No. 2619" "Cala."

Distribution.—California, Nevada, Colorado and South Dakota.

This species is of a distinct olive green color in both sexes; wings fusco-fuliginous with a violet tint. It is very similar to *arizonensis* (Cress.). Cresson described only the female of this species, while the first record that I find of a description to fit the male is by Pérez in 1901, who names his specimens *amblardi*. Pérez says that *amblardi* is very similar to *virginica* but, according to his description, there is no doubt that his species is the male of *californica* (Cresson). In 1912 Maidl recognized and described it under its right name.

Xylocopa arizonensis Cresson.

Xylocopa arizonensis Cresson, Trans. Am. Ent. Soc., VII, p. 212, ♀, ♂, 1879.

Xylocopa californica arizonensis Cockerell, South. Cal. Acad. Sc., No. 6, p. 87, June, 1904.

Xylocopa arizonensis Maidl, Ann. Nat. Hist. Hof.-Mus. Wien, p. 310, 1912.

Length of female, 25-27 mm.; of male, 22-24 mm.

Female.—Head thick, almost as wide as thorax, black, blue and purple mixed; well punctured, especially on the face; hairs entirely black; mandibles black, very wide, with two teeth, base not depressed and with few punctures, inner longitudinal groove not very deep, outer one faint; labrum semioblong, emarginate in the middle so as to form two lobes, small and black; clypeus flat, closely punctured, black and blue, longitudinal carina very faint; lateral foveolæ and frontal grooves of median depth; frontal shield iridescent, wide, flat in its lower half, deeply concaved above just beneath the point of the frontal carina, which is short, blunt, with the upper margin convex; ocelli large, median one deeply sunken, posterior ones very carinated in front, no ocellar pits present; eyes small and wide apart; antennæ of usual female type; vertex prominently raised behind the posterior ocelli, brilliantly blue colored, large and close punctures; cheeks well punctured, deep purple.

Thorax black, blue and purple, disk large and unpunctured; hair black everywhere, short and sparse above; scutellum well punctate except on anterior margin, blue colored and wide, post-scutellum narrow and well punctured.

Abdomen brilliant blue with purple reflections, punctation fine and sparse above, very abundant below, hairs everywhere black; epipygium large, wide at the base, spines stout.

Wings fuliginous, violaceous blue with purple tints, tegulæ blue. Legs bluish purple with black hairs; tibial scale large and prominent, both lower teeth sharp, the anterior one more narrowed throughout, irregularly notched above.

Male.—Differs from the other sex as follows: Head smaller, not so thick, face narrower, blue and purple; mandibles much smaller, lower tooth at apex much larger; labrum of one triangular lobe, appearing trapezoidal in some specimens; clypeus convex, more sparsely punctate, longitudinal carina more prominent; frontal shield convex and not concaved above, lateral foveolæ and frontal grooves deeper; frontal carina pointed, upper margin flat; median ocellus not deeply sunken, less carinated in front; eyes much larger, slightly converging

above, so that the face is quite reduced; vertex above flat, punctures smaller, cheeks less thickened.

Thorax having pale ochraceous hairs mixed with the black above and on the sides, black hairs below. Abdomen somewhat shorter, pale ochraceous hairs on the whole of the first segment, otherwise black; punctuation above much finer and closer on the first four segments, coarse but abundant on the remaining segments. Wings about as in female; legs with tibial scale reduced.

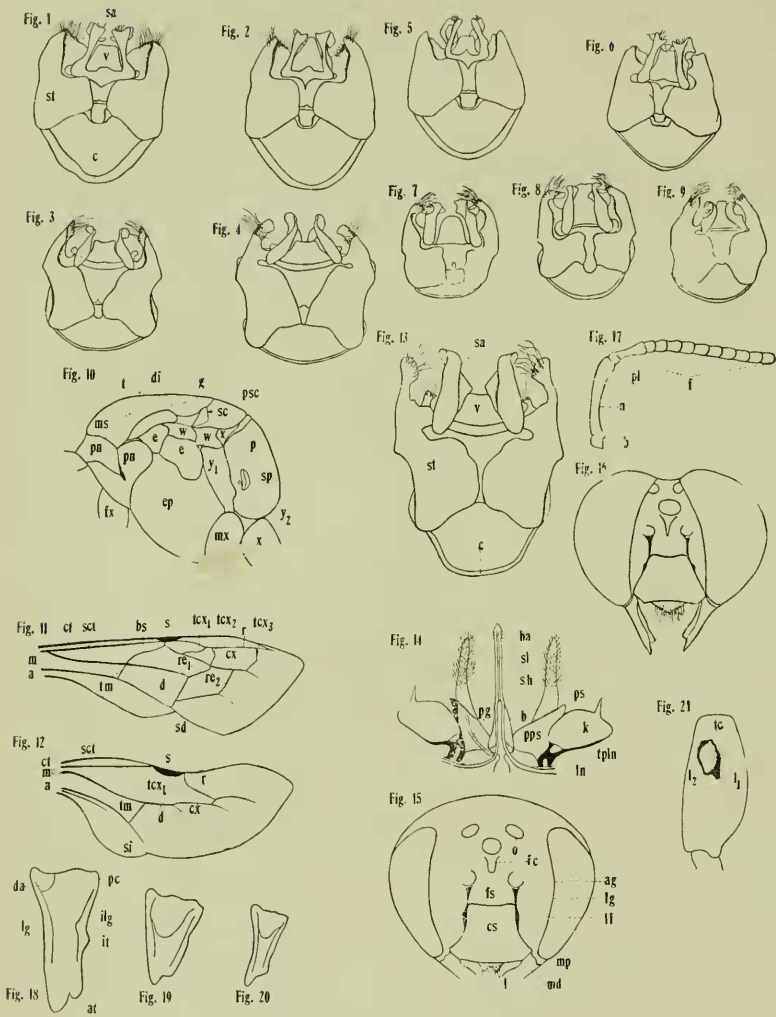
Variations.—I have a male from Alamogordo, N. M., which has been described by Cockerell as a variety (*arizonensis*) of the species *californica*. I include this individual as a variation of the species *arizonensis* (Cress.). It differs from the typical male *arizonensis* described above, only as follows: Clypeus yellow except along the lower margin where it is black; two brown longitudinal bands on the yellow area.

Types.—A female lecto-type No. 2621, from Tucson, Arizona, and a male allo-type from Prescott, Arizona, in the Acad. Nat. Sc. at Philadelphia.

Distribution.—Arizona, New Mexico, Lower California, Texas and Mexico.

This species can be recognized by its brilliant blue color and by the fuliginous, almost opaque wings. It resembles *californica* very closely and has even been called a subspecies of it. The wings of *arizonensis* are much darker and more deeply colored than those of *californica* and the color of the integument of the two species also is specifically different. Having studied the types of *arizonensis* and *californica* as well as having found a difference in the genitalia, there is no doubt in my mind that they are distinct species. The female of *arizonensis* has the hairs of the abdomen black everywhere, while the *californica* female has pale ochraceous hairs on the first abdominal segment. The male of *arizonensis* has pale ochraceous pilosity on the sides of the first abdominal segment only, while *californica* has these pale hairs on the whole first segment as well as on the hind margin laterally of segments three and four and a few along the sides of the intervening segments. From the above I see no reason why these two species should be regarded as one, even though both have many structural characters in common.

On plate III, fig. 27, of The Insect Book Howard figures *Xylocopa arizonensis*.



Xylocopa.